SECTION 7.1

RESIDENTIAL WOOD COMBUSTION

(Revised July 1997)

EMISSION INVENTORY SOURCE CATEGORY

Miscellaneous Processes/Residential Fuel Combustion

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION

610-600-0230-0000 (82115) Residential Wood Combustion - Wood Stoves

610-602-0230-0000 (82123) Residential Wood Combustion - Fireplaces

610-604-0230-0000 (47225) Residential Wood Combustion - Unspecified

METHODS AND SOURCES

This methodology is used to estimate the criteria pollutant emissions from the various types of residential wood combustion throughout the state. Emissions for wood stoves and fireplaces are included for each county. However, no annual emission estimation method has been derived, or included here, for the category "Residential Wood Combustion (Unspecified)."

Changes have occurred since the last edition of this methodology. These include changes to annual emissions and temporal profile estimates. The changes have been applied only to the San Joaquin Valley Air Basin (SJV) as of the writing of this methodology. This document will, therefore, refer to both this latest revision for the SJV (1993-based), and to the previous revision methodology (1991-based) for the remaining counties in California. For additional information on the reasoning behind this latest iteration of the methodology, the reader is directed to the supplementary documentation.[1]

The types of devices that burn wood in a typical residence are fireplaces, wood burning stoves and fireplace inserts. The most common wood burning device in a home is the fireplace. A fireplace is generally a masonry or prefabricated (metal) enclosure with the side facing the interior of the house left open and a chimney to exhaust the flue gas. The combustion air can be supplied from the outside air or from the inside air. A fireplace is an inefficient method of heating a house and in some cases can have a negative heating efficiency, if the inside air is used as combustion air. This causes the colder outside air to enter the house to balance the inside air loss due to combustion. The prefabricated fireplace is slightly higher in energy efficiency than that of a masonry fireplace.

Fireplace inserts are wood burning devices that fit into the fireplace. These devices are used to heat a house, or a portion of the house. Inserts generate heat, usually hotter than a fireplace. They radiate the heat to the interior house space, or with the aid of a fan, circulate air around the insert and vent the heated air into the house.

Wood stoves are stand alone devices that vent the flue gas through an existing chimney or flue. Wood stoves are used to heat a house or a portion of the house. Wood stoves radiate heat into the house. Because they are stand alone devices with all sides exposed to the inside of the house, the greater surface area radiates more heat.

For both the 1991-based and 1993-based inventories, the activity rates were estimated using heating degree days. A heating degree day is the number of degrees below 65 ^{O} F that an area experiences during a 24-hour day. For example, if a county has an average daily temperature of 40 ^{O} F, then the average degree day is 25.

For the 1991-based inventory, the activity rates for wood burning stoves and fireplace inserts were estimated by averaging the heating degree days from each county's 1991 weather station data. [2]

For the latest revision (the 1993-based inventory, SJV only), the elevation of each weather station was considered in analyzing each county's 1993 weather station data. [3] More explanation is included below.

The average total annual degree day is then substituted in equation 1 [4] below to estimate the energy demand of an average residence in each county.

Equation 1: $E = C_D(16.86 * q_L * DD)/(k * V *(t_{outside} - t_{inside}))$

substituting $UA = q_L/(t_{outside} - t_{inside})$

$E = C_D(16.86 * UA * DD)/(k * V)$

where: 16.86 is the estimated hours per day that wood is burned;

- E = Annual energy consumption in BTU;
- C_D = Empirical correction factor for heating effect versus 65 ^{o} F degree days. This value is 0.8;
- q_L = Design heat loss for a house, including infiltration and ventilation in BTU/hour;
- UA = Overall inside-to-outside thermal conductance for a residence. This value is estimated to be 463.28 BTU/hr ^{o}F for the average California residence. The average California residence has an area of 1,765 square feet and has R values for walls, ceilings and floors of R-13, R-19 and R-13 respectively;

DD = Number of degree days (annual or by month);

k = A correction factor that includes the effects of rated full load efficiency, part load performance, oversizing and energy conservation devices. This value is 0.6 for the average of old and new homes;

V = Heating value of fuel in BTU/cord. This value is county specific.[5,6] See Table I for the average heating value in each county;

The number of residences burning wood for heating in each county was obtained from the 1990 United States Census[7] and grown to 1993 for the counties in the SJV. The number of residences burning wood in the remaining counties was calculated according to the previous California Air Resources Board (ARB) methodology, using 1991 population numbers, and have not been adjusted based upon this latest methodology iteration.

The heating degree day is not an input for the residential fireplace category, because fireplaces as a rule are not efficient residential heaters, and their use cannot be accurately correlated with ambient temperatures. Instead, the following standard wood usage rate is applied.

The activity data for fireplaces was derived from: "Analysis of Carbon Monoxide and Inhalable Particulate Emissions from Woodburning Devices in Fresno, California,"[8] "Healdsburg Wood Heating Survey"[9] and "The California Residential Wood Consumption Survey, Draft."[10] The average wood consumption for fireplaces is estimated to be 0.28 cords per year and the number of wood burning households for each county is county dependent. To obtain the number of houses with active fireplaces, the percent wood burning household factor[10] was multiplied by the total number of households for each county minus the number of wood heating households in each county. The amount of wood burned in fireplaces for each county was estimated by multiplying the number of houses with active fireplaces by the average amount of wood burned in a fireplace.

The emission factors for woodburning stoves and fireplaces are from the United States Environmental Protection Agency's (U.S. EPA's) AP-42[11] and account for the Phase I and Phase II woodburning stoves. The emission factors are summarized below.

Emission Factors for Residential Woodburning Equipment (lb/ton)

Type of Device	NOx	SOx	CO	PM	TOG
Wood Stove/Inserts	2.6	0.4	186.0	31.1	31.0
Fireplaces	2.6	0.4	252.6	34.6	31.0

The change in methodology for the SJV Air Basin was necessary because the location of several weather stations in the southern portion of the SJV are actually on the western slopes of the Sierra Mountain range, rather than in the valley where most of the population is located.

When data for the higher elevation stations are included, the degree day numbers for those counties are inflated.

For this reason, weather stations more than 1000 feet in elevation in the SJV air basin were excluded from the data set for the latest methodology iteration (1993-based). This was done to minimize the undue influence of high elevation weather stations on the degree day analysis. The choice of 1000 feet in elevation was based on the significant climatic differences between sea-level and 1000 feet in elevation, as well as the small amount of population residing above 1000 feet in elevation. The sites below 1000 feet in elevation did not demonstrate a correlation between elevation and degree days, however, the sites higher than 1000 feet demonstrated a clear, consistent trend of larger degree day values for higher elevations. The higher elevations also had significantly higher degree day numbers than those at elevations in the zero to 600 foot range, where most of the SJV population resides. The small population above 1000 feet probably significantly outweighs the fact that residences at higher elevation sites will have underestimated heating degree day data, as well as the fact that they are more likely to burn more per household per heating degree day unit, due to their ready access to inexpensive fuel.

TEMPORAL INFORMATION

Most residential wood burning occurs during the cold season (typically in the fall, winter and early spring). The statewide cycle codes and the statewide temporal profile for wood stoves, fireplaces, and unspecified wood combustion are:

Statewide Cycle Codes

Hours	Days	Weeks
33	7	0

Statewide Temporal Profile Normalized to 1000
For CES Categories 47225, 82115, and 82123

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
182	182	127	91	0	0	0	0	0	91	145	182

The temporal profiles for the counties in the SJV air basin were each calculated separately for this latest revision. The temporal profiles for the remaining counties in California continue to be those shown above. The temporal profiles for the counties in the SJV air basin are shown below.

SJV Air Basin Temporal Profiles Normalized to 1000
For CES Categories 47225, 82115, and 82123

County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fresno	252	166	80	66	5	7	0	0	2	10	150	263
Kern	257	160	75	55	5	3	0	0	0	6	152	289
Kings	250	161	77	56	5	3	0	0	1	9	159	280
Madera	250	163	86	70	9	5	0	0	2	13	144	259
Merced	250	173	80	68	16	5	0	0	1	6	142	260
San Joaquin	236	169	83	63	13	7	0	0	3	12	154	261
Stanislaus	254	170	73	59	10	6	0	0	2	9	149	270
Tulare	250	163	79	61	5	6	0	0	1	9	154	272

ASSUMPTIONS

The emission factors used in this methodology account for the various control equipment based on a weighted average. The activity data is the best description of how much wood is being burned in each county.

The high elevation weather stations were considered not to be representative of the climate of the major population centers in the SJV air basin. The usage surveys were used to establish the annual emission numbers for fireplaces, however, the degree day profile was assumed to be a better determinant of the monthly fireplace usage than the profile established from the usage surveys.

RELIABILITY FACTOR

The reliability factor has not been determined.

CHANGES IN METHODOLOGY

Improvements were made to the annual emissions inventory and the temporal profile methodology for the SJV air basin only. The changes affect both the residential wood stove and fireplace source categories. Although the temporal profile information is intended for use for the "Residential Wood Combustion (Unspecified)" category as well, no annual emission estimates exist at this time for this category.

The populations for the SJV counties were grown from the 1990 census data to 1993 levels for both the wood stove and the fireplace categories. The calculations for the remaining counties in California continue to use the 1990 census data grown to 1991 population levels. For the

SJV air basin only, the heating degree day data from the weather monitoring sites higher than 1000 feet in elevation were excluded from the calculations of annual emissions for wood stoves.

All three residential wood combustion categories use the same temporal profile. The new methodology uses the heating degree day value as an input to improve the temporal profiles used for these categories. The previous temporal profile was applied statewide, and was developed from usage data. The exclusion of SJV weather stations more than 1000 feet in elevation also applies to the temporal profiles.

DIFFERENCES BETWEEN 1991 AND 1993 EMISSION ESTIMATES

Growing the SJV population from 1991 to 1993 levels increases the emissions proportionately for both the wood stove and fireplace categories. Excluding SJV air basin weather stations more than 1000 feet in elevation reduces the woodstove emissions in counties which include mountainous regions (Fresno, Kern, Madera and Tulare counties), but has no effect on counties lacking high elevation weather stations.

The exclusion of the high elevation weather stations does not affect the annual emissions for residential fireplaces. Wood usage rather than degree days determined the activity levels for fireplaces.

Most of the decrease in estimated woodstove PM emissions in the SJV resulting from excluding stations more than 1000 feet, occurs in the spring and fall, not during the peak winter woodburning season. This occurs because daily average winter valley temperatures are closer to daily average mountain temperatures than spring and fall. Therefore, excluding weather stations more than 1000 feet in elevation shifts the woodstove emissions profile more into the winter months from the 1991-based methodology. This results in significant changes between the "Statewide" percent of yearly emissions profile as included in the 1991-based inventory, and the new 1993-based methodology normalized profiles applied to the SJV. In this latest iteration of the methodology, the normalized version of this profile is also used for the SJV fireplace and unspecified category profiles.

RECOMMENDATIONS

The accuracy of the residential wood burning category might be increased in several ways. Activity factors can be refined through surveys of wood heating devices, fireplaces and wood products (wood, Duraflame logs and Presto logs) usage. Also, it is likely that the composition of the wood population burned is unique to that county or area. The types of wood burned need to be evaluated and a composite wood heating factor estimated.

The feasibility of using precipitation or cloud cover, in addition to degree day data, to

determine fireplace usage rates should be studied. Other nonclimatic factors, such as holidays, cost and ease of fuel acquisition, etc., could also be worked into the calculation.

Annual emission estimates should be derived for the source category "Residential Wood Combustion (Unspecified)." Surveys must be conducted of the manufacturers of these devices, as well as the end users before this can be accomplished.

The changes implemented here for the SJV air basin could be applied to the rest of California. Similar analyses should be conducted to those performed in the supplemental documentation [1] to determine if certain weather stations should be excluded for the analyses of the regions outside the SJV.

As with many area source methodologies, the possibility of incorporating geographic information system data may allow more accurate depictions of local emissions inventories.

SAMPLE CALCULATIONS

Estimating Annual Emissions for Residential Wood Stoves

Fresno County has 10,953 houses that burn wood for heat and 2,217 heating degree days in 1993. The emission calculations for woodburning stoves and fireplace inserts are as follows:

From Equation 1 the energy requirement for all 10953 residences is:

E = 0.8*(16.86 hr * 463.28 BTU/hr ^{o}F * 2217 ^{o}F)/(0.6 * 20,000,000 BTU/cord) * 10,953 houses

E = 12,644.23 cords or 25,288.46 tons of wood.

Multiplying the emission factors for woodburning stoves and inserts by E, above, produces the annual PM emissions for Fresno County, which are shown, along with the other counties' emissions, in Table II.

Estimating Annual PM Emissions for Residential Fireplaces

The emission from fireplaces in Fresno County are estimated by multiplying the number of houses in the county by the fraction of those houses that have active fireplaces, and then subtracting the number of houses in the county with residential wood stoves or fireplace inserts, and then multiplying by the estimated amount of wood that is burned in a typical fireplace annually. The calculations are presented below:

E = ((fraction of active fireplaces * number of houses) - number of wood heating houses) * (amount of wood burned per house)

E = ((0.403 * 231,379 houses) - 9,668 houses) * 0.28 cords/house

E = 23,402 cords or 46,804 tons of wood.

Multiplying the emission factors for fireplaces by E, above, produces the annual PM emissions for Fresno County, which are shown, along with the other counties' emissions, in Table III.

Estimating Monthly PM Emissions for Residential Wood Stoves

Fresno County has 10,953 houses that burn wood for heat and 558 heating degree days in January, 1993. The emission calculations for woodburning stoves and fireplace inserts are as follows:

From Equation 1 the energy requirement for all 10,953 residences is:

E = 0.8*(16.86 hr * 463.28 BTU/hr^{o}F * 557.75 ^{o}F)/(0.6*20,000,000 BTU/cord) * 10,953 houses

E = 3,181.14 cords or 6,362.28 tons of wood.

Multiplying the emission factors for woodburning stoves and inserts by E, above, produces the January PM emissions for Fresno County. The other months' emissions are calculated in the same manner. All the monthly emissions are then summed to create the annual value, and then the monthly emissions are divided by the annual value to create the normalized monthly emissions. For the purposes of clarity in the tables, the monthly emissions are normalized to an annual sum of 1000. However, when being used for calculations they should be normalized to 1.0. The normalized monthly emissions for the SJV are shown above. The remaining county profiles were not recalculated in this iteration, and continue to use the statewide emission profile from the 1991-based methodology iteration.

Estimating Monthly PM Emissions for Residential Fireplaces

The monthly emissions from fireplaces in Fresno County are estimated by multiplying the annual emissions as listed in Table II by the monthly emissions profile (after first dividing each month by 1000 to normalize to 1.0) derived for Residential Wood Stoves.

DEFINITION OF TERMS

BTU: British thermal unit (the amount of energy to increase the temperature of one pound of water one degree Fahrenheit (1°F)).

Cord: The amount of wood that occupies 128 cubic feet.

Heating degree day: The number of heating degree days is the number of degrees that the average daily temperature is below 65°F.

Phase I stoves: U.S. EPA designation for stoves certified to meet a 5.5 grams per hour (gm/hr) for catalytic wood heaters and 8.5 gm/hr noncatalytic wood heaters particulate matter emission standards manufactured on or after July 1, 1988 or sold after July 1, 1990.

Phase II stoves: U.S. EPA designation for stoves certified to meet a 4.1 gm/hr for catalytic wood heaters and 7.5 gm/hr for noncatalytic wood heaters particulate matter emissions standards manufactured on or after July 1, 1990 or sold after July 1, 1992.

Ton: 2000 pounds.

ADDITIONAL CODES

SOURCE CATEGORY GROWTH AND CONTROL CODES

82115 GROWTH=510, CONTROL=99
82123 GROWTH=510, CONTROL=99
47225 GROWTH=510, CONTROL=99

SOURCE CATEGORY CODE POLLUTANT SPECIATION PROFILES

82115 VOC=549, PM=138
82123 VOC=549, PM=138
47225 VOC=549, PM=138

SOURCE CATEGORY CODE REACTIVITY FACTORS

Not Available

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REFERENCES

1. Francis, Stephen R., San Joaquin Valley Air Basin: Proposed Revisions to the Annual PM10 and Temporal PM10 Emissions Profiles for Residential Wood Stoves (CES: 82115); and the Temporal PM10 Emissions Profile for Residential Fireplaces (CES: 82123), Supplementary Documentation to Section 7.1, Residential Wood Combustion Inventory Methodology, May 1996.

2. National Oceanic and Atmospheric Administration, Climatological Data California 1991 Vol. 95 Numbers 1-13.

3 National Oceanic and Atmospheric Administration, Climatological Data California 1993 Vol. 97 Numbers 1-13.

4. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1989 ASHRAE Handbook Fundamentals I-P Edition.

5. Personal Communication with Jay Fenton, Energy Works Wholesale, February 1993.

6. Personal Communication with Ron Cowan, Horizon Forest Products, February 1993.

7. U.S. Department of Commerce, Bureau of Census, 1990 Census of Population and Housing - Summary Tape File 3A.

8. Engineering-Science, Analysis of Carbon Monoxide and Inhalable Particulate Emissions from Woodburning Devices in Fresno, California, October 1982.

9. Tolmasoff, M., Junker, T., Healdsburg Wood Heating Survey, January, 1990.

10. Northern California Research Associates, The California Residential Wood Consumption Survey, Draft, May 1988.

11. U.S. EPA, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, October 1992.

TABLE I
BTU Rating of Wood Burned in
Residential Wood Burning Appliances

County Name	BTU Rating (BTU/Cord)10^7
Alameda	2.00
Alpine	1.50
Amador	1.75
Butte	1.75
Calaveras	1.75
Colusa	1.75
Contra Costa	2.00
Del Norte	1.50
El Dorado (SV)	1.75
El Dorado (LT)	1.50
Fresno	2.00
Glenn	1.75
Humboldt	1.50
Imperial	1.50
Inyo	1.50
Kern (SED)	2.00
Kern (SJV)	2.00
Kings	2.00
Lake	1.75
Lassen	1.50
Los Angeles (SC)	2.00
Los Angeles (SED)	2.00
Madera	2.00
Marin	2.00
Mariposa	1.75
Mendocino	1.50
Merced	2.00
Modoc	1.50
Mono	1.50
Monterey	1.75
Napa	2.00
Nevada	1.50
Orange	2.00
Placer (LT)	1.50
Placer (MC)	1.75
Placer (SV)	2.00
Plumas	1.50
Riverside (SED)	2.00
Riverside (SC)	2.00
Sacramento	2.00
San Benito	1.75
San Bernardino (SC)	2.00
San Bernardino (SED)	2.00
San Diego	2.00

Table I (continued)

BTU Rating of Wood Burned in
Residential Wood Burning Appliances

County Name	BTU Rating (BTU/Cord)10^7
San Francisco	2.00
San Joaquin	2.00
San Luis Obispo	1.75
San Mateo	2.00
Santa Barbara	1.75
Santa Clara	2.00
Santa Cruz	1.75
Shasta	1.50
Sierra	1.50
Siskiyou	1.50
Solano (SF)	1.75
Solano (SV)	2.00
Sonoma (NC)	1.75
Sonoma (SF)	2.00
Stanislaus	2.00
Sutter	1.75
Tehama	1.75
Trinity	1.50
Tulare	2.00
Tuolumne	1.75
Ventura	1.75
Yolo	1.75
Yuba	1.75

Table II
1991 or 1993* Area Source Emissions
Activity: Residential
Process: Fuel Combustion
Entrainment: Wood - Combustion
Dimn: Wood Stove Residential
CES: 82115
Process Rate Unit: Tons Burned

AB	County	Process Rate	TOG Emis. (Tons / Year)	CO Emis. (Tons / Year)	NOX Emis. (Tons / Year)	SOX Emis. (Tons / Year)	PM Emis. (Tons/ Year)
GBV	ALPINE	2392	37.00	222.40	3.10	0.40	37.20
	INYO	14889	230.70	1384.60	19.70	2.90	231.70
	MONO	23085	357.80	2146.80	30.50	4.60	359.30
LC	LAKE	27139	420.60	2523.90	35.90	5.40	422.40
LT	EL DORADO	67979	493.60	2962.00	42.20	6.30	495.70
	PLACER	4268	396.90	396.90	5.60	0.80	66.40
MC	AMADOR	18711	290.00	1740.10	24.70	3.70	291.20
	CALAVERAS	30291	469.50	2817.10	40.10	6.00	471.40
	EL DORADO	31850	1053.60	6322.00	90.00	13.60	1058.10
	MARIPOSA	17764	275.30	1652.00	23.50	3.80	276.40
	NEVADA	106243	1646.70	9880.50	140.70	21.20	1653.60
	PLACER	8219	127.30	764.30	10.80	1.60	127.90
	PLUMAS	44405	688.20	4129.60	58.80	8.80	691.10
	SIERRA	5810	90.00	540.30	7.70	1.10	90.40
	TUOLUMNE	39042	605.10	3630.90	51.70	7.80	607.70
NC	DEL NORTE	19157	296.60	1781.50	25.30	3.80	298.10
	HUMBOLDT	68388	1060.00	6360.10	90.60	13.60	1064.40
	MENDOCINO	46068	714.00	4284.30	61.00	9.20	717.00
	SONOMA	6962	107.90	647.40	9.20	1.30	108.30
	TRINITY	22087	342.30	2054.00	29.20	4.40	343.70
NCC	MONTEREY	14464	224.10	1345.10	19.10	2.80	225.10
	SAN BENITO	2842	44.00	264.30	3.70	0.50	44.20
	SANTA CRUZ	33741	522.90	3137.90	44.70	6.70	525.10
NEP	LASSEN	48002	744.00	4464.20	63.60	9.60	747.10
	MODOC	20536	318.30	1909.80	27.20	4.10	319.60
	SISKIYOU	75783	1174.60	7047.80	100.40	15.10	1179.50
SC	LOS ANGELES	16030	248.40	1490.70	21.20	3.20	249.50
	ORANGE	2639	40.90	245.40	3.50	0.50	41.00
	RIVERSIDE	1902	77.70	466.40	6.60	1.00	78.00
	SAN BERN	19937	309.00	1854.10	26.40	3.90	310.30
SCC	SAN LUIS	17787	275.70	1654.10	23.50	3.50	276.80
	SANTA BARBA	4265	66.10	396.60	5.60	0.80	66.30
	VENTURA	3414	52.90	317.50	4.50	0.60	53.10
SD	SAN DIEGO	35115	544.20	3265.60	46.50	7.00	546.50
SED	IMPERIAL	301	4.60	28.00	0.40	0.00	4.60
	KERN	2710	42.00	252.00	3.50	0.50	42.10
	LOS ANGELES	311	4.80	28.90	0.40	0.00	4.80
	RIVERSIDE	5015	29.40	176.80	2.50	0.30	29.60
	SAN BERN	4708	72.90	437.80	6.20	0.90	73.20
SF	ALAMEDA	12973	198.29	1189.71	16.95	2.56	199.12
	CONTRA COSTA	14202	220.13	1320.75	18.82	2.84	221.05
	MARIN	8016	124.24	745.45	10.62	1.60	124.76
	NAPA	7969	123.53	741.16	10.56	1.59	124.05
	SAN FRAN	1868	28.95	173.70	2.47	0.37	29.07
	SAN MATEO	10937	169.53	1017.17	14.49	2.19	170.24
	SANTA CLARA	17348	268.89	1613.33	22.99	3.47	270.02
	SOLANO	6582	102.02	612.12	8.72	1.32	102.45
	SONOMA	38042	107.91	3537.86	50.41	7.61	592.12
SJV	FRESNO	25289	391.92	2351.79	33.45	5.01	393.62
	KERN	14260	221.04	1326.14	18.88	2.82	221.96
	KINGS	2564	39.72	238.43	3.34	0.48	39.91
	MADERA	18313	283.83	1703.09	24.18	3.62	285.05
	MERCED	10791	167.17	1003.47	14.28	2.14	167.96
	SAN JOAQUIN	17711	274.51	1647.05	23.39	3.51	275.68
	STANISLAUS	16414	254.41	1526.46	21.68	3.20	255.48
	TULARE	13459	208.55	1251.64	17.82	2.67	209.49
SV	BUTTE	51201	793.60	4761.60	67.80	10.20	796.90
	COLUSA	2894	44.80	269.10	3.80	0.50	45.00
	GLENN	6478	100.40	602.50	8.50	1.30	100.80
	PLACER	42101	652.50	3915.40	55.70	8.40	655.30
	SACRAMENTO	15701	243.30	1460.10	20.80	3.10	244.30
	SHASTA	103103	1598.10	9588.60	136.60	20.60	1604.80
	SOLANO	2811	43.50	261.30	3.70	0.50	43.70
	SUTTER	7731	119.80	719.00	10.20	1.50	120.30
	TEHAMA	38790	601.20	3607.50	51.40	7.70	603.70
	YOLO	6393	99.00	594.50	8.40	1.20	99.50
	YUBA	12288	190.40	1142.80	16.20	2.40	191.20
TOTAL		1440480	22170.84	133945.42	1905.95	285.70	22415.93

Fraction of Reactive Organic Gases (FROG): .4482 (Reactive Organic Gases (ROG) Emissions = TOG X FROG)
Fraction of PM10 (FRPM10): .9200 (PM10 Emissions = PM X FRPM10)

*The SJV Counties have been updated using the latest methodology, and reflect the 1993 population estimates. Emissions for the remaining counties were made using the 1991-based methodology.

Table III
1991 or 1993* Area Source Emissions
Activity: Residential
Process: Fuel Combustion
Entrainment: Wood - Combustion
Dimn: Fireplace Residential
CES: 82123
Process Rate Unit: Tons Burned

AB	County	Process Rate	TOG Emis. (Tons / Year)	CO Emis. (Tons / Year)	NOX Emis. (Tons / Year)	SOX Emis. (Tons / Year)	PM Emis. (Tons/ Year)
GBV	ALPINE	387	6.00	6.70	0.50	0.10	4.90
	INYO	707	11.00	89.30	0.90	0.10	12.20
	MONO	3276	50.80	413.80	4.30	0.70	56.70
LC	LAKE	3715	57.60	469.20	4.80	0.70	64.30
LT	EL DORADO	5600	30.50	248.50	2.60	0.40	34.00
	PLACER	879	13.60	111.00	1.10	0.20	15.20
MC	AMADOR	1144	131.80	144.50	1.50	0.20	19.80
	CALAVERAS	2217	34.40	280.00	2.90	0.40	38.30
	EL DORADO	1967	86.80	707.30	7.30	1.10	96.90
	MARIPOSA	1438	22.30	181.60	1.90	0.30	24.90
	NEVADA	4780	74.10	603.80	6.20	1.00	82.70
	PLACER	1974	13.60	111.00	1.10	0.20	15.20
	PLUMAS	2093	32.40	264.30	2.70	0.40	36.20
	SIERRA	350	5.40	44.20	0.50	0.10	6.00
	TUOLUMNE	2181	33.80	275.40	2.80	0.40	37.70
NC	DEL NORTE	1259	19.50	159.00	1.60	0.30	21.80
	HUMBOLDT	5779	89.60	729.90	7.50	1.20	100.00
	MENDOCINO	3732	57.80	471.40	4.90	0.70	64.60
	SONOMA	3929	60.90	496.20	5.18	0.80	68.00
	TRINITY	482	7.50	60.80	0.60	0.10	8.30
NCC	MONTEREY	17362	269.10	2192.90	22.60	3.50	300.40
	SAN BENITO	1709	26.50	215.80	2.20	0.30	29.60
	SANTA CRUZ	16176	250.70	2043.00	21.00	3.20	279.80
NEP	LASSEN	768	11.90	97.00	1.00	0.20	13.30
	MODOC	143	2.20	18.10	0.20	0.00	2.50
	SISKIYOU	1701	26.40	214.90	2.20	0.30	29.40
SC	LOS ANGELES	274009	4247.10	34607.30	356.20	54.80	4740.40
	ORANGE	109618	1699.10	13844.70	142.50	21.90	1896.40
	RIVERSIDE	37605	582.90	4749.50	48.90	7.50	650.60
	SAN BERN	76929	1192.40	9716.10	100.00	15.40	1330.90
SCC	SAN LUIS	14841	230.00	1874.40	19.30	3.00	256.70
	SANTA BARBAR	23006	356.60	2905.70	29.90	4.60	398.00
	VENTURA	31834	493.40	4020.70	41.40	6.40	550.70
SD	SAN DIEGO	122975	1906.10	15531.80	159.90	24.60	2127.50
SED	IMPERIAL	1130	17.50	142.70	1.50	0.20	19.50
	KERN	3784	58.70	477.90	4.90	0.80	65.50
	LOS ANGELES	5307	82.30	670.30	6.90	1.10	91.80
	RIVERSIDE	14264	221.10	1801.50	18.50	2.90	246.80
	SAN BERN	18162	281.50	2293.90	23.60	3.60	314.20
SF	ALAMEDA	68744	1065.50	8682.30	89.40	13.70	1189.30
	CONTRA COSTA	53694	832.30	6781.60	69.80	10.70	928.90
	MARIN	21669	335.90	2736.90	28.20	4.30	374.90
	NAPA	6352	98.50	802.30	8.30	1.30	109.90
	SAN FRAN	25935	402.00	3275.60	33.70	5.20	448.70
	SAN MATEO	40212	623.30	5078.80	52.30	8.00	695.70
	SANTA CLARA	80067	1241.00	10112.50	104.10	16.00	1385.20
	SOLANO	17659	273.70	2230.30	23.00	3.50	305.50
	SONOMA	24542	380.40	3099.70	31.90	4.90	424.60
SJV	FRESNO	46804	725.47	5911.33	60.80	9.33	809.70
	KERN	32052	496.80	4048.27	41.73	6.40	554.50
	KINGS	4459	69.07	563.24	5.73	0.93	77.10
	MADERA	7065	109.48	892.39	9.20	1.47	122.20
	MERCED	8690	134.66	1097.65	11.32	1.80	150.30
	SAN JOAQUIN	29291	454.01	3699.51	38.13	5.87	506.70
	STANISLAUS	22733	352.39	2871.16	29.60	4.53	393.30
	TULARE	17518	271.48	2212.62	22.80	3.47	303.10
SV	BUTTE	8501	131.80	1073.60	11.10	1.70	147.10
	COLUSA	620	14.40	117.50	1.20	0.20	16.10
	GLENN	1063	16.50	134.20	1.40	0.20	18.40
	PLACER	11554	179.10	1459.30	15.00	2.30	199.90
	SACRAMENTO	70063	1086.00	8849.00	91.10	14.00	1212.10
	SHASTA	9139	141.70	1154.30	11.90	1.80	158.10
	SOLANO	3494	54.20	441.30	4.50	0.70	60.40
	SUTTER	4679	72.50	591.00	6.10	0.90	80.90
	TEHAMA	1722	26.70	217.50	2.20	0.30	29.80
	YOLO	4729	73.30	597.30	6.10	0.90	81.10
	YUBA	1445	22.40	182.50	1.90	0.30	25.00
TOTAL		1443707	22479.46	182199.77	1876.09	288.40	24960.20

Fraction of Reactive Organic Gases (FROG): .4482 (Reactive Organic Gases (ROG) Emissions = TOG X FROG)
Fraction of PM10 (FRPM10): .9200 (PM10 Emissions = PM X FRPM10)

*The SJV Counties have been updated using the latest methodology, and reflect the 1993 population estimates. Emissions for the remaining counties were made using the 1991-based methodology.